MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015 / 2016

PPH0135 - ELECTRICITY AND MAGNETISM

(Foundation in Engineering)

13 OCTOBER 2015
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **SIX (6)** printed pages excluding the cover page with **FOUR (4)** questions.

2. Answer **ALL** questions. The distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

QUESTION 1 (15 marks)

a) Sketch the direction of magnetic field of a magnet bar. Label accordingly. (2 marks)

b) Given the direction of magnetic field, B and motion of charge, v for each charge, q are as shown in **Figure Q1.1, Figure Q1.2** and **Figure Q1.3**. Determine the direction of resultant magnetic force (if any) exerted on each charge. You may copy the whole diagram into your answer script. (3 marks)

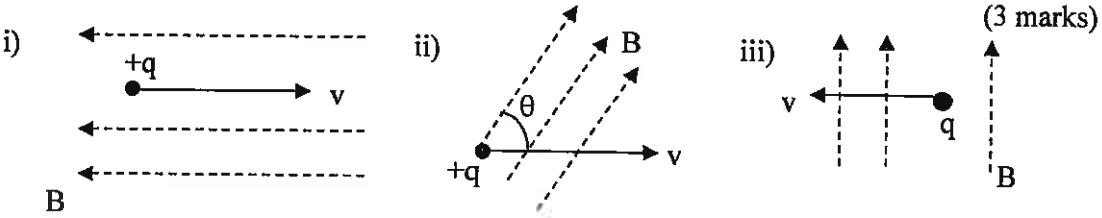

Figure Q1.1 **Figure Q1.2** **Figure Q1.3**

c) Under what circumstances do you use the following hand's rule ?

i) Fleming's left hand rule
ii) Right hand rule (2 marks)

d) There are two conductors carries current I_1 and I_2 as shown in **Figure Q1.4**. Answer the following questions:

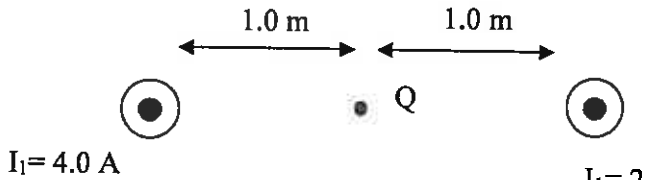

Figure Q1.4

i) Copy the whole **Figure Q1.4** onto your answer script and sketch the direction of magnetic field produces by each conductor at point Q. Label accordingly. (2 marks)

ii) Calculate individual magnitude of magnetic field produces by each conductor at point Q. (2 marks)

iii) What law do you use to determine the answer in (ii) ? (1 mark)

iv) From (ii), determine the magnitude of net magnetic field at point Q. (1 mark)

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e) Determine the direction of induced current (if any) produces in the loop, for the following **Figure Q1.5**. Explain your answer.

(2 marks)

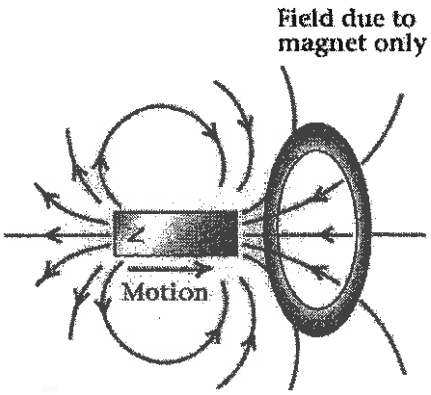

Figure Q1.5

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QUESTION 2 (15 marks)

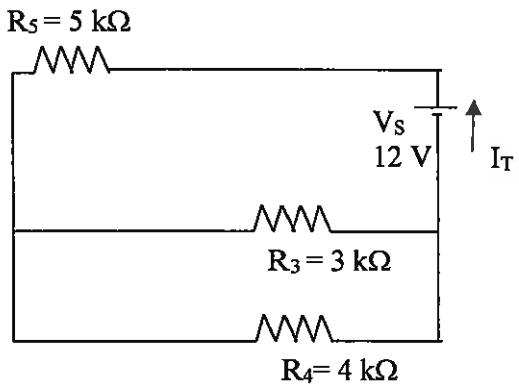

Figure Q2.1

Answer the following questions based on **Figure Q2.1**:

a) Copy **Figure Q2.1** onto your answer script and show direction of all currents flow across each resistors. Label accordingly.

(3 marks)

b) Combine resistors R_3 and R_4, R_{34}.

(1 mark)

c) Using voltage divider rule, calculate voltage across R_{34}, V_{34} and voltage across R_5, V_5.

(2 marks)

d) From (c), determine the total current flows, I_T, across R_5.

(1 mark)

e) From (d), using current divider rule, calculate currents across R_3, I_3 and across R_4, I_4.

(2 marks)

f) Using Kirchhoff Current Law and any values found in previous calculations, verify the current flows across R_5, I_T found in (d).

(1 mark)

g) Using Thevenin's method, determine Thevenin's voltage, V_{Th} and Thevenin's resistance, R_{Th} if load resistor is R_3.

(2 marks)

h) Sketch Thevenin's equivalent circuit based on the answer found in (g). Thus verify the current flows across R_3, I_3 found in (e).

(2 marks)

i) Determine Norton's resistance, R_N if load resistor is R_3.

(1 mark)

Continued...

QUESTION 3 (10 marks)

Figure Q3.1 shows a series *RCL* circuit has a 100.0 Ω resistor, a 200.0 μF capacitor and a 300.0 mH inductor connected across an *ac* generator operating at 50.0 Hz and voltage source of 75.0 V.

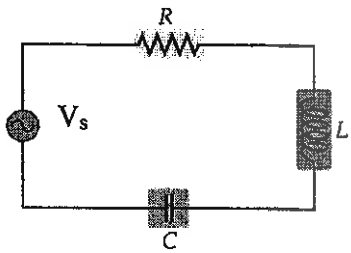

Figure Q3.1

a) Determine the reactance of inductor (X_L) and capacitor (X_C).

(2 marks)

b) Determine the impedance, Z of the whole circuit.

(1 mark)

c) From (b), determine the total current across the whole circuit, I_T.

(1 mark)

d) Sketch a phasor diagram showing reactance of inductor as well as capacitor, resistance and impedance of the circuit.

(2 marks)

e) Determine the power factor, cos ϕ .

(1 mark)

f) Obtain apparent power, reactive power and average power for this circuit.

(3 marks)

QUESTION 4 (10 marks)

a) Differentiate the term valence band and conduction band.

(2 marks)

b) i) What type of material be added into semiconductor material in order to produce P-type semiconductor ?

(1 mark)

ii) Sketch the atomic structure which explaining your reason in (i).

(2 marks)

c) Sketch a simple graph of current versus voltage, showing diode characteristic during both forward and reverse bias.

(2 marks)

d) Sketch schematic symbol for PNP transistor and label the direction of currents across each terminal.

(2 marks)

e) How many PN junctions are there for a PNP transistor ?

(1 mark)

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APPENDIX I

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	9.11×10^{-31} kg
Proton mass,	m_p	1.67×10^{-27} kg
Elementary charge	e	1.602×10^{-19} C
Gravitational constant	G	6.67×10^{-11} N.m^2/kg^2
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_o	-13.6 eV
Boltzmann's constant	k_B	1.38×10^{-23} J/K
Compton wavelength	λ_c	2.426×10^{-12} m
Planck's constant	h	6.626×10^{-34} J.s
Speed of light in vacuum	c	3.0×10^8 m/s
Rydberg constant	R_H	1.097×10^7 m^{-1}
Acceleration due to gravity,	g	9.81 m /s^2
Atomic mass unit (1u)	u	1.66×10^{-27} kg
Avogadro's number	N_A	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing	I_o	1.0×10^{-12} W /m^2
Coulomb constant	k	8.988×10^9 N m^2 /C^2
Permittivity of free space	ε_o/κ_o	8.85×10^{-12} C^2/N.m^2
Permeability of free space	μ_o	$4\pi \times 10^{-7}$ H/m

Energy equivalent of atomic mass unit:
One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

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APPENDIX II

List of formulas

$$A_v = \frac{V_c}{V_b}$$

$$\alpha_{dc} = \frac{\beta_{dc}}{\beta_{dc}+1}$$

$$\beta_{dc} = \frac{\alpha_{dc}}{1-\alpha_{dc}}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \mu_0 nI$$

$$\xi = V + Ir$$

$$\xi = blv$$

$$\xi = -N\frac{\Delta\Phi}{\Delta t}$$

$$\xi = -L\frac{dI}{dt}$$

$$\xi = -M\frac{dI}{dt}$$

$$F = BIL\sin\theta$$

$$F = qvB\sin\theta$$

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$I_{tot} = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I = neA(v_n + v_p)$$

$$I = nev_d A$$

$$I = I_{max}\sin\omega t$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$I_x = \left(\frac{R_T}{R_x}\right)I_T$$

$$L = \frac{N\Phi_B}{I}$$

$$L = \frac{\mu_o N^2 A}{l}$$

$$M = \frac{N\Phi_B}{I}$$

$$M = \frac{\mu_o N_1 N_2 A}{l}$$

$$P = IV = I^2R = \frac{V^2}{R}$$

$$P_t = I_{rms}V_{rms}\cos\phi$$

$$P_r = V_{rms}I_{rms}\sin\phi$$

$$P_a = I_{rms}^2 Z$$

$$R = \frac{\rho L}{A}$$

$$R = R_0\left[1+\alpha(T-T_0)\right]$$

$$R_T = R_1 + R_2 + R_3 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

$$r = \frac{mv}{Bq}$$

$$\tau = NBIA\sin\theta$$

$$U = \frac{1}{2}LI^2$$

$$U = \frac{1}{2}B^2 A\frac{l}{\mu_o}$$

$$V_H = Bvd$$

$$V = V_{max}\sin\omega t$$

$$V_{rms} = \frac{V_{max}}{\sqrt{2}}$$

$$V_x = \left(\frac{R_x}{R_T}\right)V_S$$

$$X_C = \frac{1}{2\pi fC}$$

$$X_L = 2\pi f L$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\oint B.dl = \mu_o I$$

$$d\mathbf{B} = \frac{\mu_O I}{4\pi}\frac{d\ell\times\hat{\mathbf{r}}}{r^2}$$

$$\Phi_B = BA\cos\theta$$

$$\cos\phi = \frac{R}{Z}$$

$$\tan\phi = \frac{X_L - X_C}{R}$$

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